PFAS – Managing the shifting sands of science and regulation with an emerging contaminant

ROSS EDWARDS - PRINCIPAL

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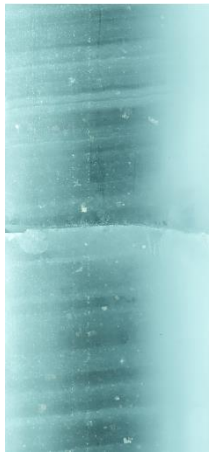
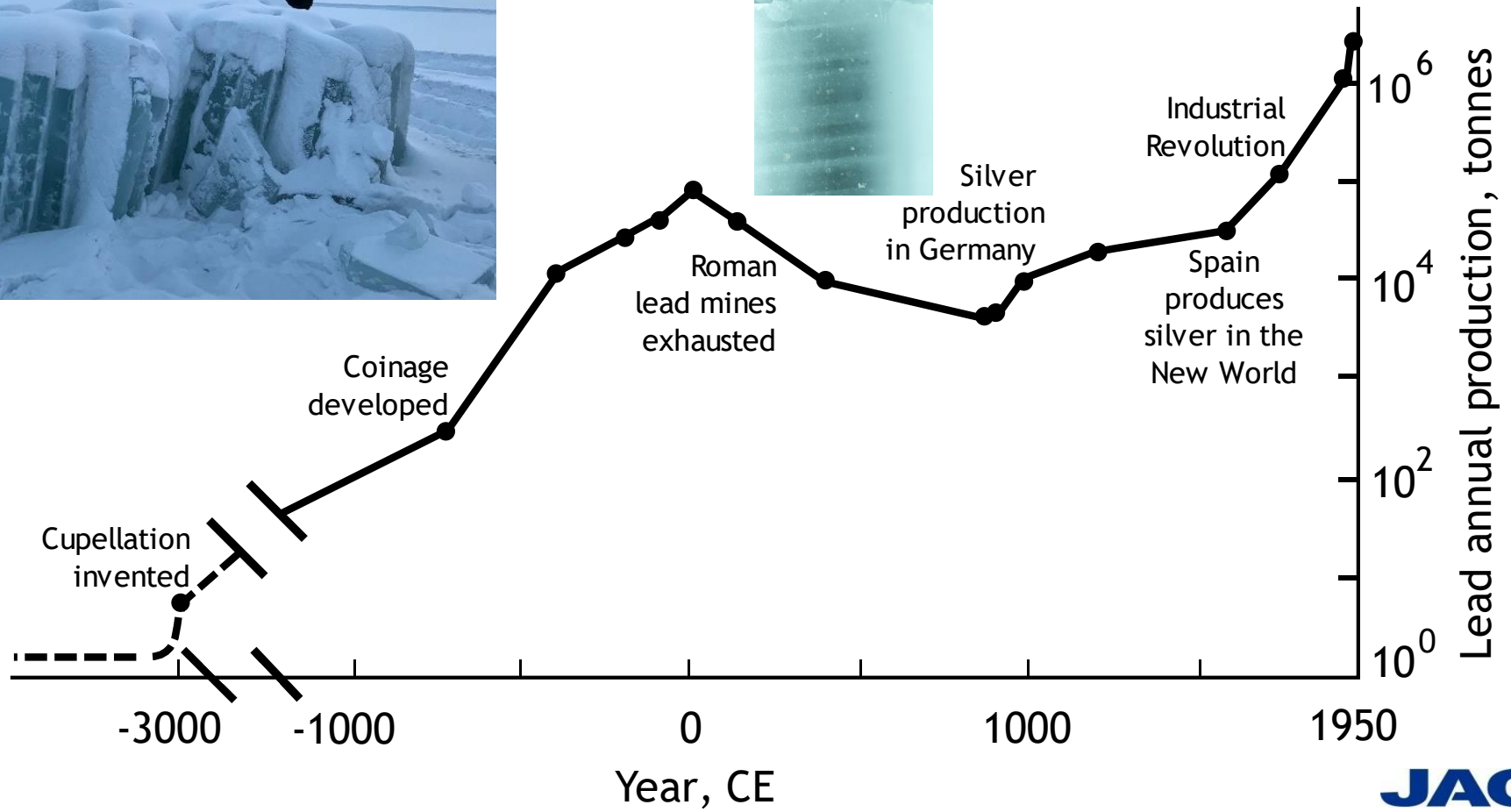
A Shifting Risk Paradigm?





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Modern Response to CLM

- Precautionary Principal
- Licencing of industrial and commercial premises - Discharge limits
- Pollution abatement and Clean Up Notices
- National Environment Protection (Assessment of Site Contamination) Measures and revision

Tier 1 Screening Levels – Soil (mg/kg)

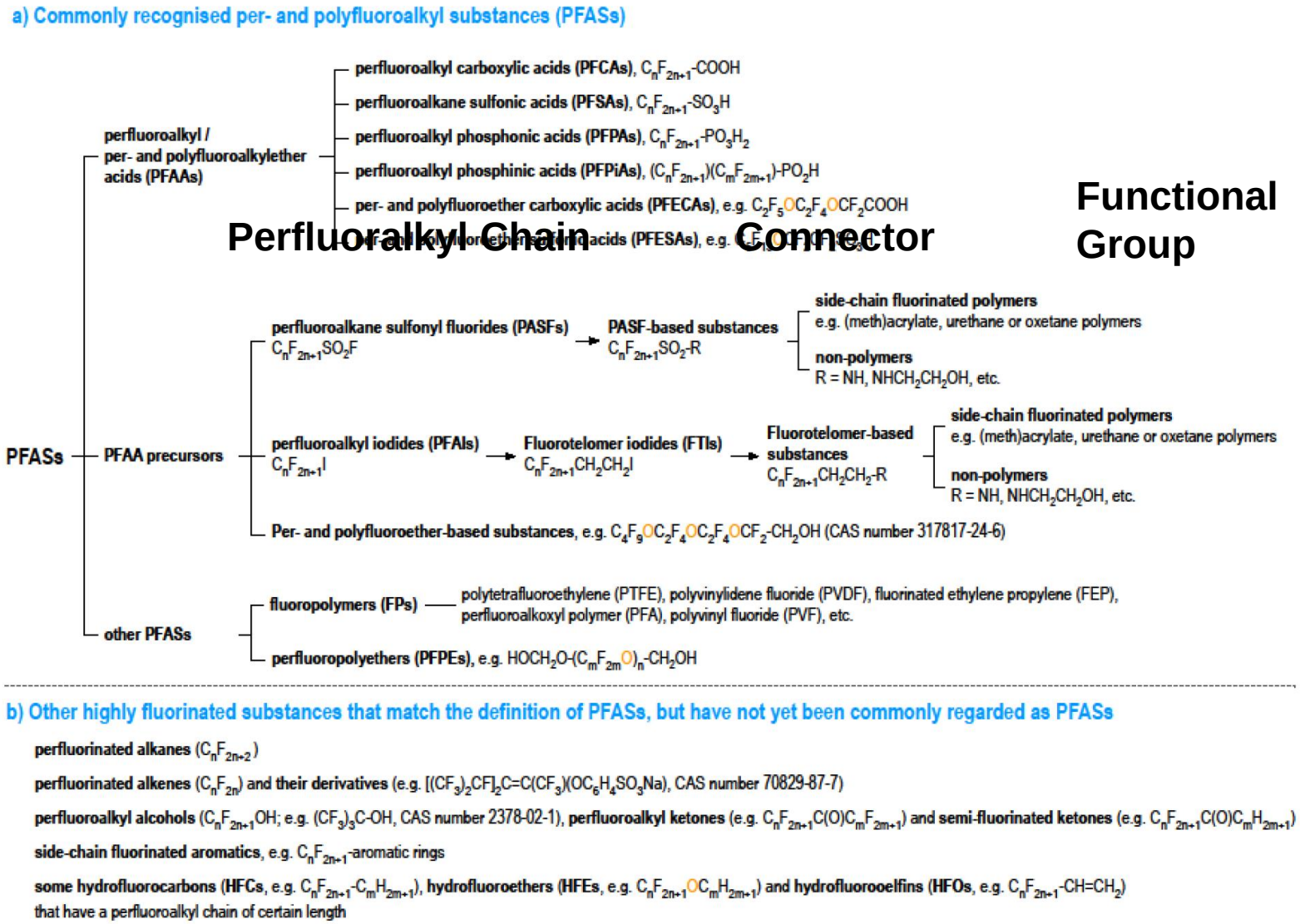
- ANZECC 1992 – Few criteria used Dutch A-B-C and even use of ICRCL
- National Environment Protection (Assessment of Site Contamination) Measure – first in 1999, then revised and issued in 2013
- PFAS NEMP – Local numbers based on FSANZ, Canadian ecotox

Substances	ICRCL (UK)[1]	ANZEC 1992/Dutch B[2]	NEPM 1999 – HIL A	NEPM 2013 – HIL A	PFAS NEMP 2018 - Residential
Lead	500	150	300	300 – 1100 (>2yrs old)	-
Petroleum Hydrocarbons					-
Mineral Oil (HC Mixtures)	-	1000 (5000 Dutch C)	5000[4]	-	-
$C_6 – C_{10}$ (- Sum BTEXN)	-	-	-	45 (sand) – 50 (clay) <1 m depth	-
$>C_{10} – C_{16}$ (- naphthalene)	-	-	-	110 (sand) – 280 (clay) <1 m depth	-
$> C_{16} – C_{35}$ Aromatics	-	-	90	-	-
$> C_{16} – C_{35}$ Aliphatics	-	-	5600	-	-
C_{35} Aliphatics	-	-	56000	-	-
PAH (Total)	50	20	20	300	-
Benzo (a) pyrene	-	1	1	3 (BAP TEQ)	-
Benzene	-	0.5	1[4]	0.5 (sand) – 0.7 (clay) <1m depth	-
PCB (Total)	-	1	10	1	-
Vinyl Chloride	-	5[3]	0.1[4]	0.03 (mg/m^3)	-
PFAS					
6:2 FTS	-			60	-
PFOS	-	-	-	6	0.009
PFOA	-	-	-	16	0.1
PFHxS				-	0.009

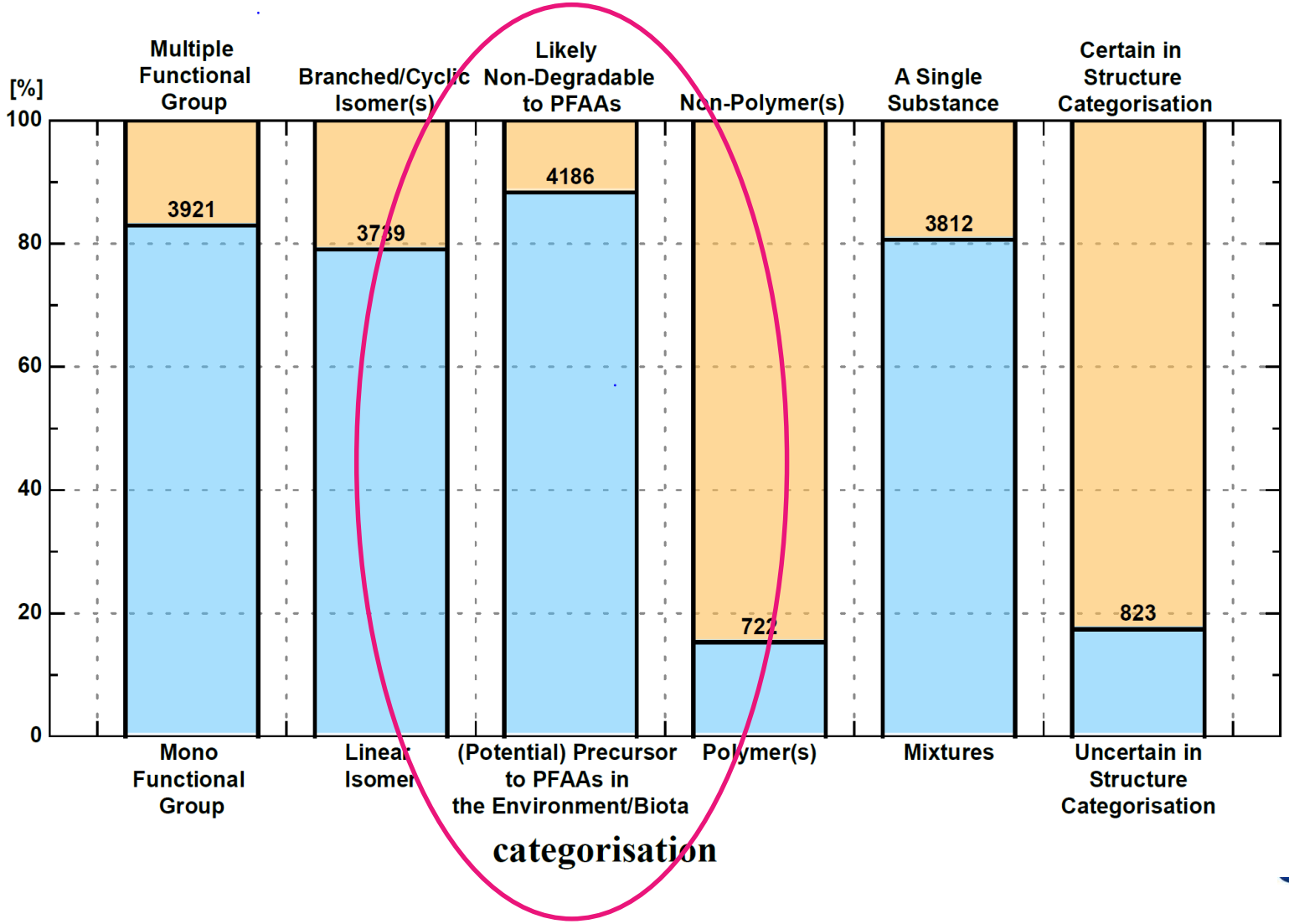
NOTES

1: ICRCL 59/83 Guidance on the Assessment and Development of Contaminated Land – Threshold Levels (regarded as uncontaminated)
2: Netherlands A-B-C – Value pollutant should be investigated more thoroughly
3: Dutch value for individual aliphatic compounds
4: Dutch 2000 Intervention Levels

PFAS – What Are they?



OECD – 4730 PFAS



PFAS Use - AFFF

- PFAS AFFF Very effective on Class B Fires – Flammable and Combustible Liquids
- Use often mandated (e.g. Insurance, Major Hazard Facilities, Design)
- Supress vapours, reduces static, prevents re-ignition

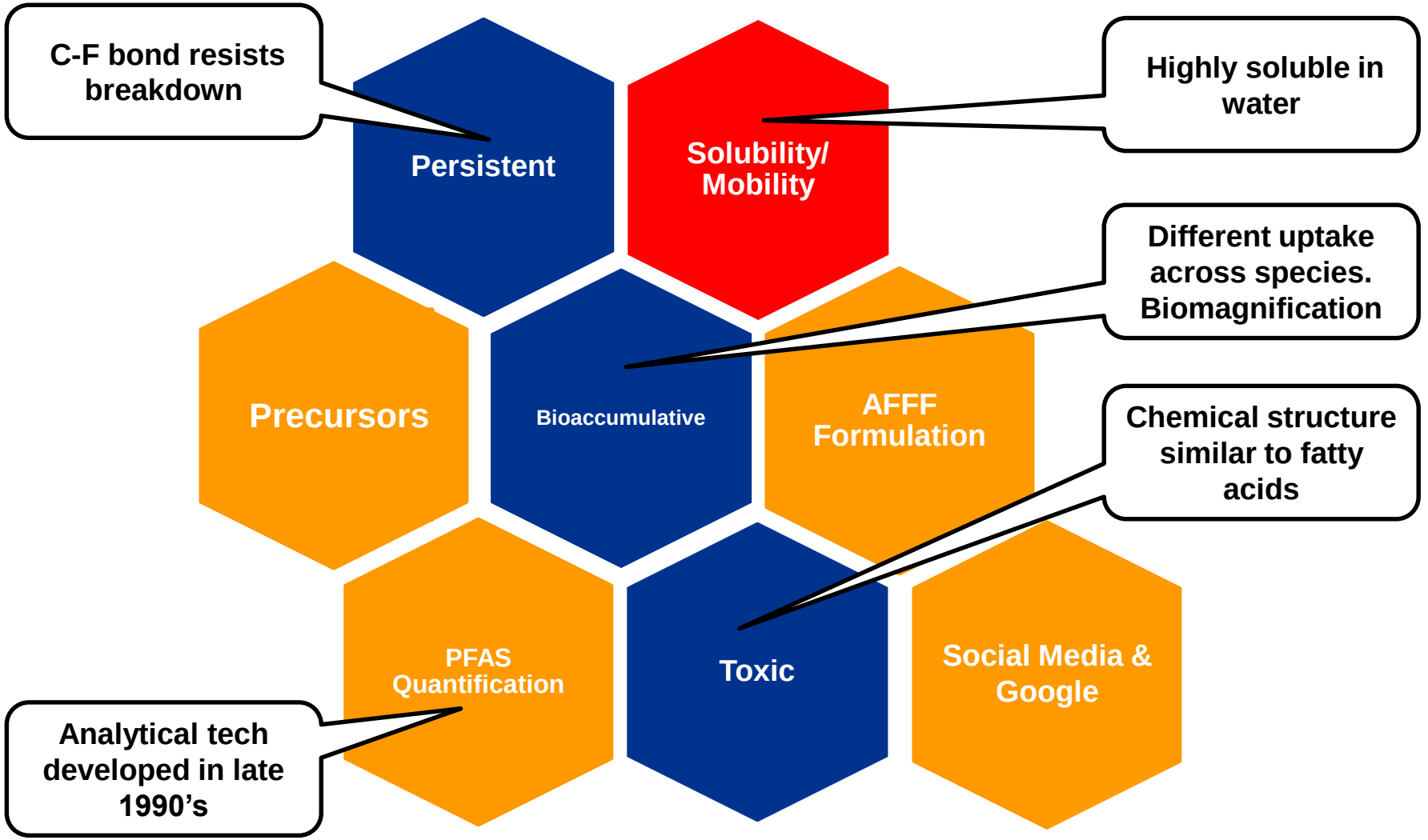
http://williamsfire.com/files/PDFs/TFPP-C8-

Other Potential Sources are available

Other PFAS Sources

- **Landfills**
- **Electroplating**
- **Wastewater Treatment**
- **Biosolids – land application**
- **Chemical Storage**

PFAS – Changing Risk Paradigm – PBT+S



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Secret Formulas?

- **Poor regulation on AFFF SDS**
- **Legislation allows manufacturers to say no data available (<1% vol. & variable ID of PFAS)**
- **Proprietary information**

Thunderstorm FC-601A

MATERIAL SAFETY DATA SHEET

Date Prepared: 3/26/2010
Supersedes Date: New

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

Product Name: **Thunderstorm FC-601A**

Chemical Family: Surfactant mixture, fire fighting foam concentrate, aqueous film forming foam.

Company Identification: Chemguard, Inc.
204 South 6th Avenue
Mansfield, Texas 76063 USA
(817) 473-9964 (For Product Information)
(817) 473-9964 (For Emergency Information)
www.chemguard.com

Chemical Name	Percentage	CAS Number	OSHA Hazard
Water	Balance	7732-18-5	NO
Diethylene glycol monobutyl ether	4 – 13 %	112-34-5	YES
Polysaccharide gum	1 – 2 %	Proprietary	YES
Proprietary hydrocarbon surfactants	NA	Proprietary	YES
Proprietary fluorosurfactants	NA	Proprietary	YES

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW
WARNING! MAY CAUSE EYE AND/OR SKIN IRRITATION

Routes of Exposure:

Eye Contact: Exposure during the handling or mixing may cause immediate or delayed irritation or inflammation.

Skin Contact: Exposure during the handling or mixing may cause immediate or delayed irritation or inflammation.

Ingestion: Ingestion of large quantities may cause abdominal cramps, nausea, vomiting, diarrhea.

Inhalation: Exposure to this product in excess of the applicable TVL or PEL may cause or aggravate other lung conditions. Exposure to this product may cause irritation to the nose, throat, and upper respiratory system.

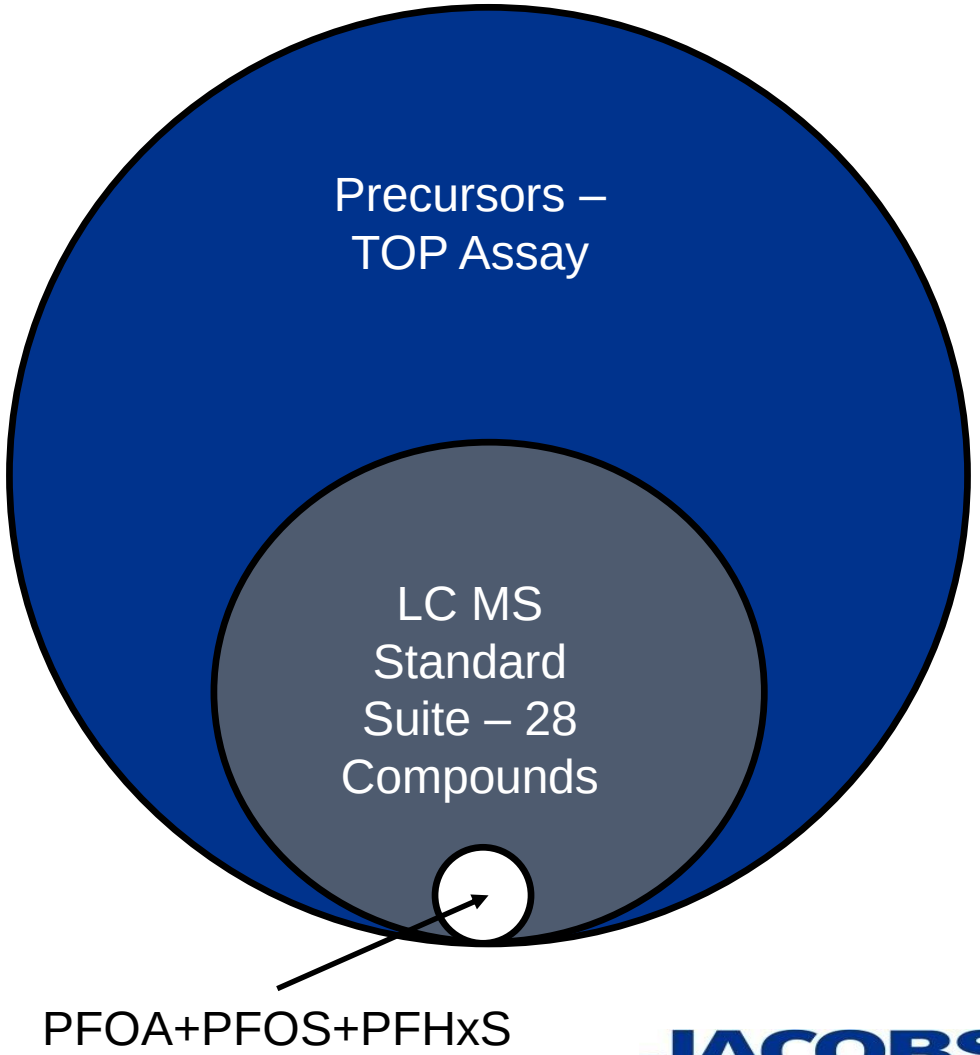
Chronic: None known

Medical Conditions which May be Aggravated by Inhalation or Dermal Exposure: Persons with unusual (hyper) sensitivity to chemicals may experience adverse reactions to this product.

CHEMGUARD Page 1 of 6 Last Updated 9/08/2009

Precursors

- Degradation
- PFAS tend to degrade at a few stable end products – PFOS, PFOA



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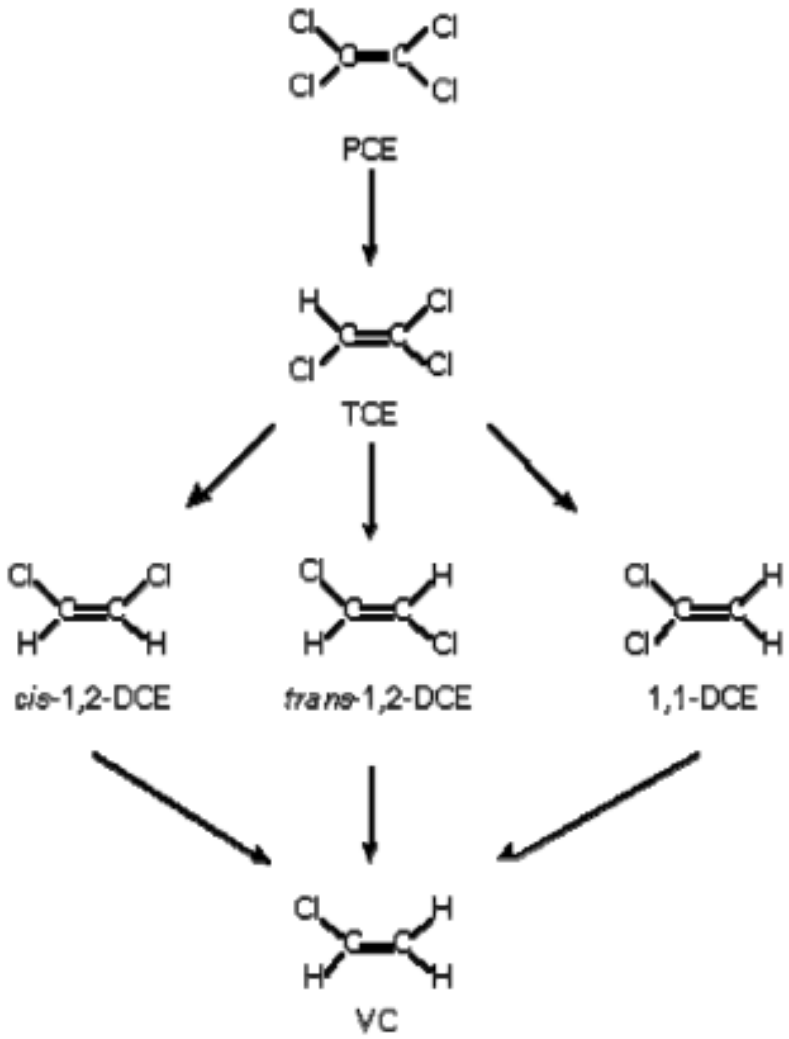
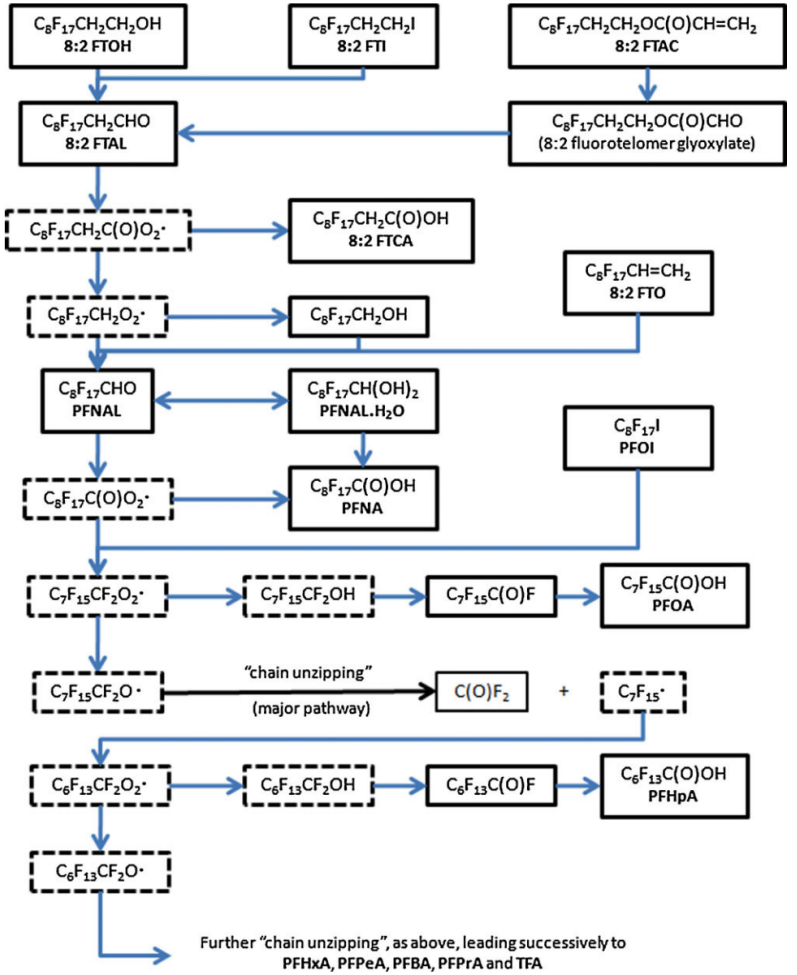
Precursors & Partial Degradation

Solvent



PFAS



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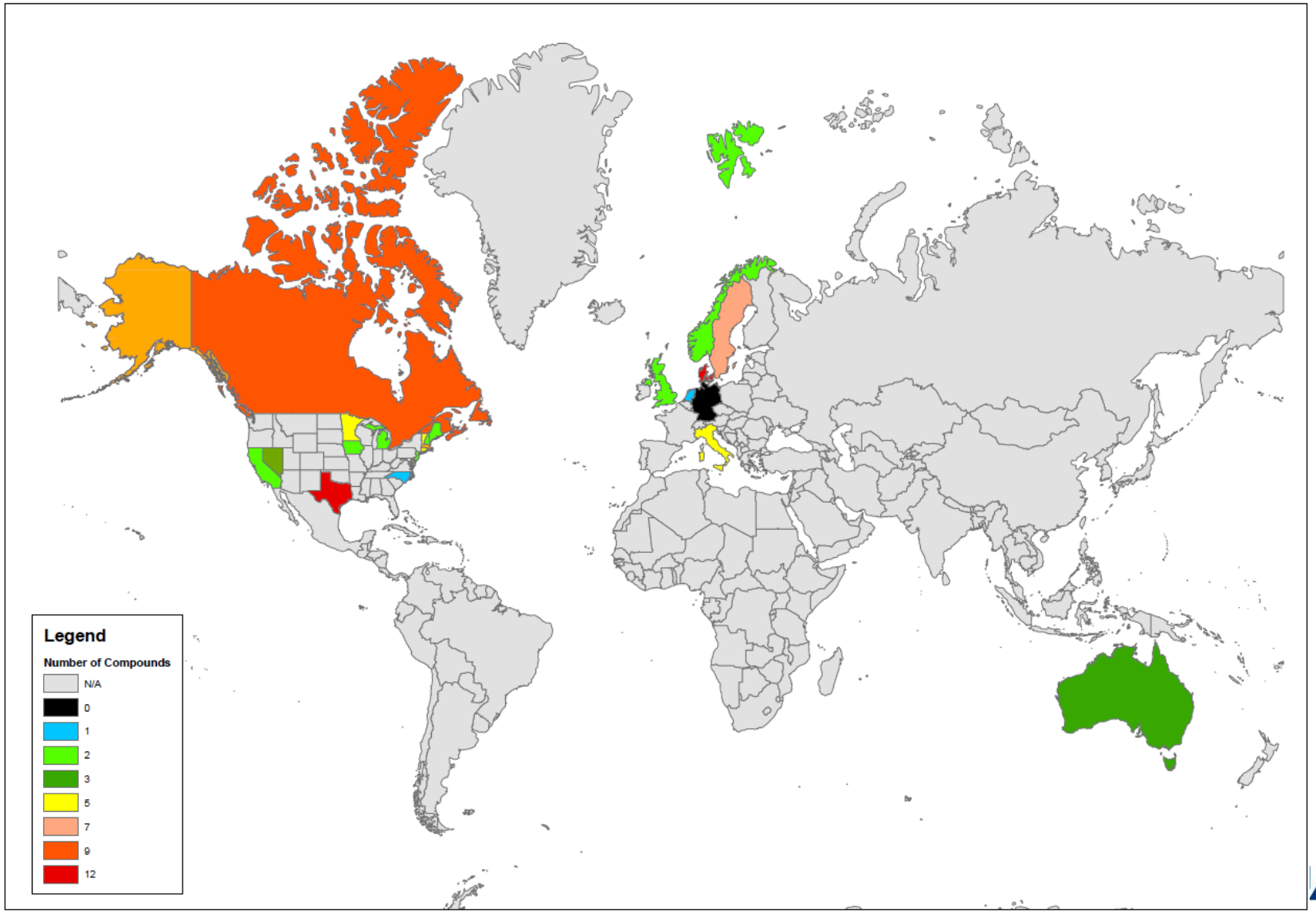
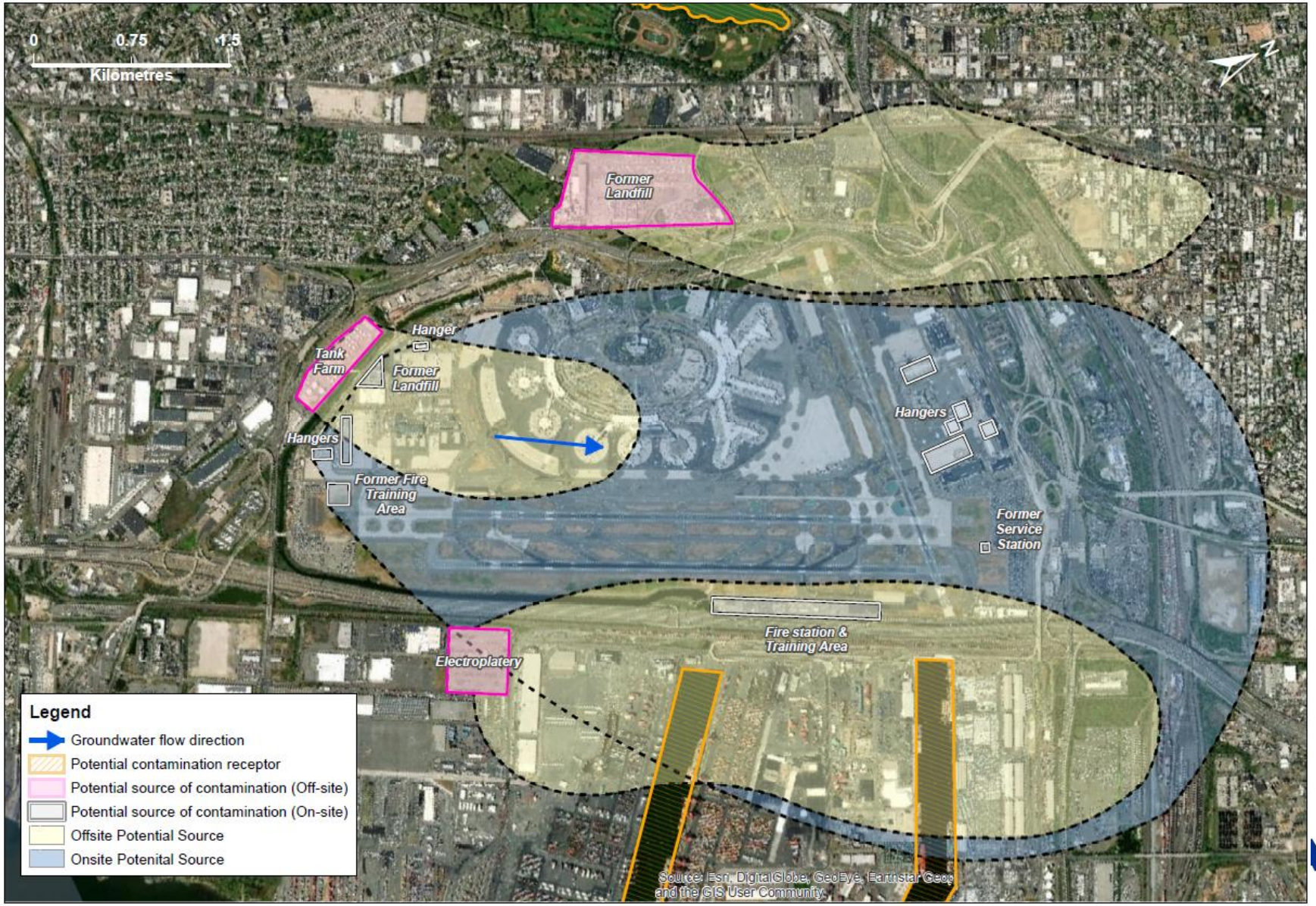
Global – No. PFAS With DW Criteria



A Theoretical Scenario



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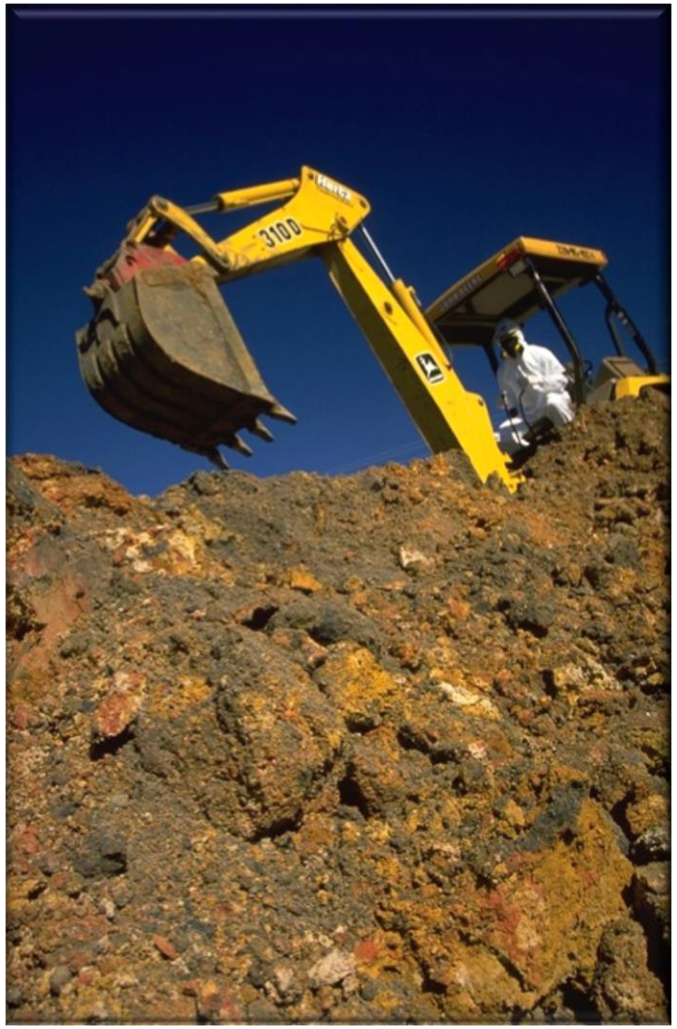
Soil Remediation Overview

- Excavation
  - Landfilling retains liability
- Stabilization/Sorption
  - RemBind (Ziltek's carbon, activated alumina, kaolin clay)
  - Not clean closure
- Soil washing
  - Waste stream handling
- Thermal
  - Low or high temperature



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Soil - Thermal

Study	Thermal Method	Initial Total PFAS Conc. (µg/kg)	% Reduction in Total PFAS	Exposure Temperature/Time	PFAS Analysed
Jacobs	Infrared Heating	200	26	250˚C for 8 days	24 PFAS analyzed
Jacobs	Vapor Energy Generator	40	Minimal 50 >99.9	482˚C for 15 mins 593˚C for 15 mins 954˚C for 30 mins	10 PFAA analyzed
Jacobs	Infrared Heating	290	89.3-99.8 97.3-100 99.8-100	400˚C for 60 mins 550˚C for 50 mins 700˚C for 80 mins	24 PFAS analyzed
Confidential	Rotary Kiln	175	>99.9	450˚C for <20 min	20 PFAS analyzed
Confidential	Rotary Kiln	1200	>99	700˚C for <20 min	16 PFAS Analyzed

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Groundwater Treatment (others may be available)

Technology	Advantages	Considerations
Reverse Osmosis	Short-chain, can clean/regenerate	Dealing with rejected stream – pre-treat
Ozone Fractionation	Can handle high organics	Multiple-stage process
Flocculation/Coagulation	Combinations can address short and long chain PFAS	Disposal of flocculant
Electrochemical Precipitation/Oxidation	Precursor transformation	Tests indicate minimal PFOS destruction
In-situ – Chemical Oxidation & Foam Fractionation	Less Ex-situ Palava	Earlier stages of development
In-situ Biodegradation	Use of biological processes to treat precursors	Time, only precursors

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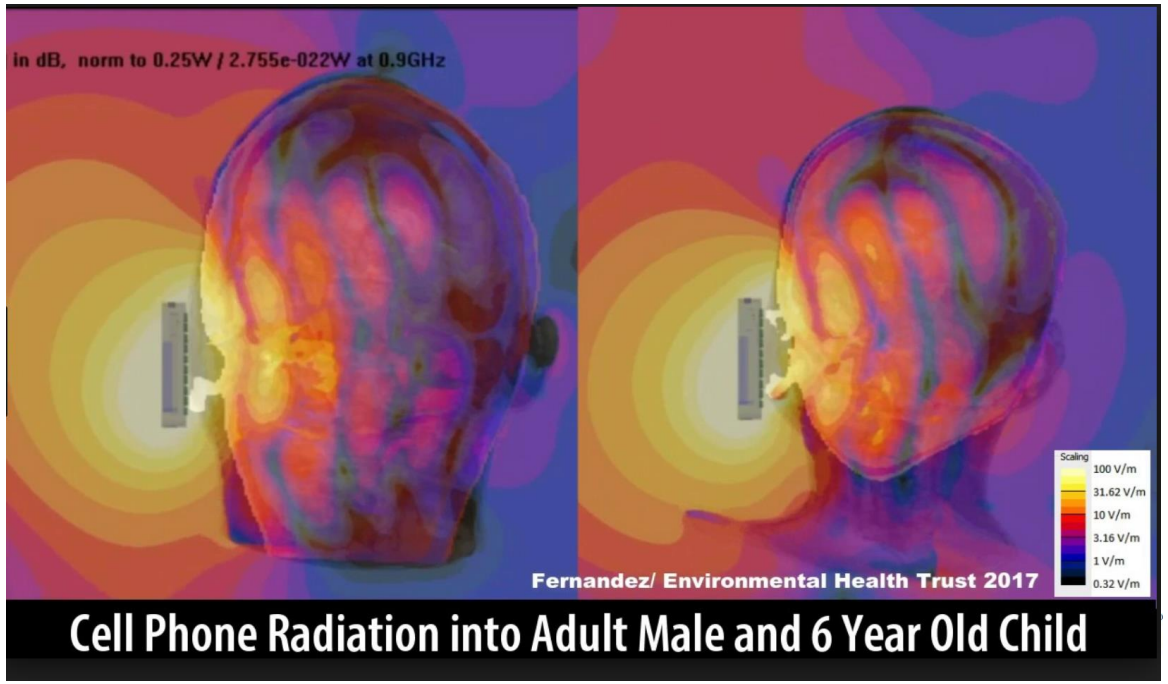
Summary - Management, Remediation and Stakeholders

- Phase our PFAS in AFFF without compromising performance is on the horizon
- Publication of criteria give people something more tangible – PFAS NEMP Revision <12 months
- Remedial solutions have matured – deal with large diffuse plumes and waste
- Stakeholders - Risk context is important – unlike phones risk is involuntary
- Risk Assessment – focus on those that partially degrade to the more stable end products



Have We Learned?

Pruitt asks Cabinet to help him with 'war on lead' in drinking water

by Josh Siegel | Feb 5, 2018, 4:45 PM

Environmental Protection Agency Administrator Scott Pruitt invited Cabinet members to a Feb. 15 meeting to discuss a strategy to update the nation's water infrastructure. (AP Photo/Pablo Martinez Monsivais)

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Thanks

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Tier 1 Screening Levels - Groundwater

Substances	ICRCL (UK)[1]	ANZEC 1992/Dutch B[2]	NEPM 1999 – Drinking Water	NEPM 2013 – Drinking Water	PFAS NEMP 2018 – Drinking Water
Lead	-	50	10	10	-
Petroleum Hydrocarbons	-	-			-
Mineral Oil (HC Mixtures)	-	200	600[3]	-	-
$C_6 – C_{10}$ (- Sum BTEXN)	-	-	-	1	-
$>C_{10} – C_{16}$ (- naphthalene)	-	-	-	1	-
PAH (Total)	-	10	3	-	-
Benzo (a) pyrene	-	0.2	0.01	0.01	-
Benzene	-	1	1	1	-
PCB (Total)	-	0.2	0.001	0.01[4]	-
Vinyl Chloride	-	10	0.3	0.3	-
PFAS	-	-	-		
6:2 FTS	-	-	-	5	-
PFOS	-	-	-	0.2	0.07[5]
PFOA	-	-	-	0.4	0.56
PFHxS	-	-	-	-	0.07[5]

NOTES

1: Aquatic Ecosystem – Fresh water criteria – Drinking water not specified
2: Netherlands A-B-C – Value pollutant should be investigated more thoroughly
3: Dutch 2000 Intervention Levels
4: Freshwater – Aroclor 1254 – Bioaccumulation potential
5: Criteria for PFOS + PFHxS

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